# DATA SHEET

# TDA1020
## 12 W car radio power amplifier

Product specification
File under Integrated Circuits, IC01

November 1982

Philips Semiconductors

PHILIPS

# 12 W car radio power amplifier TDA1020

The TDA1020 is a monolithic integrated 12 W audio amplifier in a 9-lead single in-line (SIL) plastic package. The device is primarily developed as a car radio amplifier. At a supply voltage of $V_P = 14,4$ V, an output power of 7 W can be delivered into a 4 Ω load and 12 W into 2 Ω.

To avoid interferences and car ignition signals coming from the supply lines into the IC, frequency limiting is used beyond the audio spectrum in the preamplifier and the power amplifier.

The maximum supply voltage of 18 V makes the IC also suitable for mains-fed radio receivers, tape recorders or record players. However, if the supply voltage is increased above 18 V (< 45 V), the device will not be damaged (load dump protected). Also a short-circuiting of the output to ground (a.c.) will not destroy the device. Thermal protection is built-in. As a special feature, the circuit has a low stand-by current possibility.

The TDA1020 is pin-to-pin compatible with the TDA1010.

## QUICK REFERENCE DATA

| | | | | |
|---|---|---|---|---|
| Supply voltage range | $V_P$ | | 6 to 18 | V |
| Repetitive peak output current | $I_{ORM}$ | < | 4 | A |
| Output power at $d_{tot}$ = 10% (with bootstrap) | | | | |
| $V_P = 14,4$ V; $R_L = 2$ Ω | $P_o$ | > | 10 | W |
| | | typ. | 12 | W |
| $V_P = 14,4$ V; $R_L = 4$ Ω | $P_o$ | typ. | 7 | W |
| $V_P = 14,4$ V; $R_L = 8$ Ω | $P_o$ | typ. | 3,5 | W |
| Output power at $d_{tot}$ = 10% (without bootstrap) | | | | |
| $V_P = 14,4$ V; $R_L = 4$ Ω | $P_o$ | > | 4,5 | W |
| Input impedance | | | | |
| preamplifier (pin 8) | $\|Z_i\|$ | typ. | 40 | kΩ |
| power amplifier (pin 6) | $\|Z_i\|$ | typ. | 40 | kΩ |
| Total quiescent current at $V_P = 14,4$ V | $I_{tot}$ | typ. | 30 | mA |
| Stand-by current | $I_{sb}$ | < | 1 | mA |
| Storage temperature range | $T_{stg}$ | | –55 to + 150 | °C |
| Crystal temperature | $T_c$ | max. | 150 | °C |

## PACKAGE OUTLINE

9-lead SIL; plastic (SOT110B); SOT110-1; 1996 July 24.

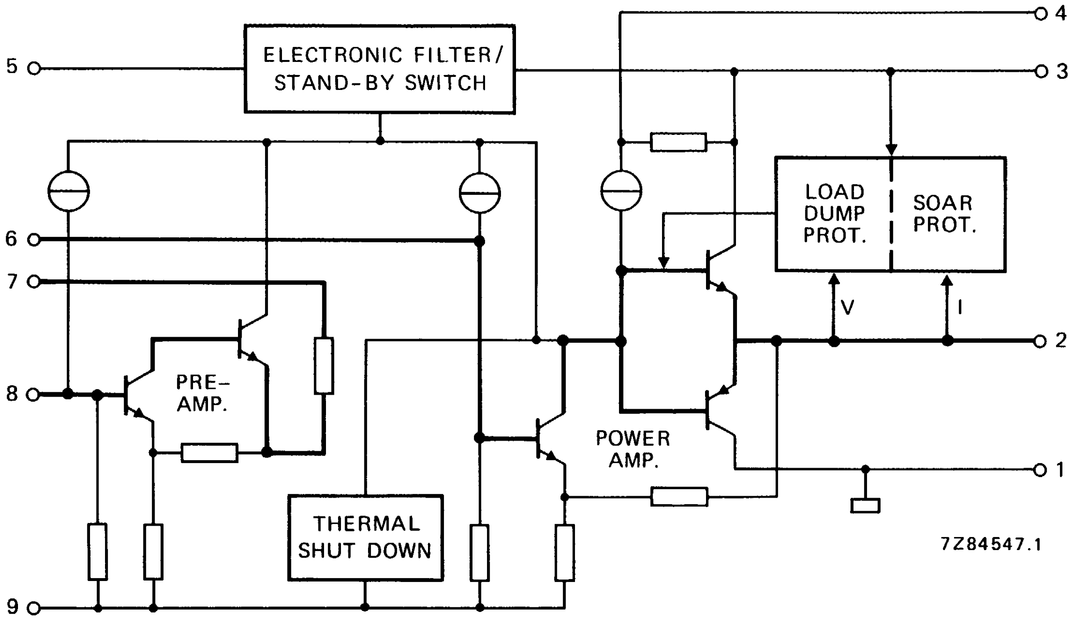



Fig.1 Internal block diagram; the heavy lines indicate the signal paths.

## PINNING

1. Negative supply (substrate)
2. Output power stage
3. Positive supply ($V_P$)
4. Bootstrap
5. Ripple rejection filter
6. Input power stage
7. Output preamplifier
8. Input preamplifier
9. Negative supply

**RATINGS**

Limiting values in accordance with the Absolute Maximum System (IEC 134)

| | | | |
|---|---|---|---|
| Supply voltage; operating (pin 3) | $V_P$ | max. | 18 V |
| Supply voltage; non-operating | $V_P$ | max. | 28 V |
| Supply voltage; load dump | $V_P$ | max. | 45 V |
| Non-repetitive peak output current | $I_{OSM}$ | max. | 6 A |
| Total power dissipation | see derating curves Fig.2 | | |
| Storage temperature range | $T_{stg}$ | | –55 to + 150 °C |
| Crystal temperature | $T_c$ | max. | 150 °C |
| Short-circuit duration of load behind output electrolytic capacitor at 1 kHz sine-wave overdrive (10 dB); V = 14,4 V | $t_{sc}$ | max. | 100 hours |

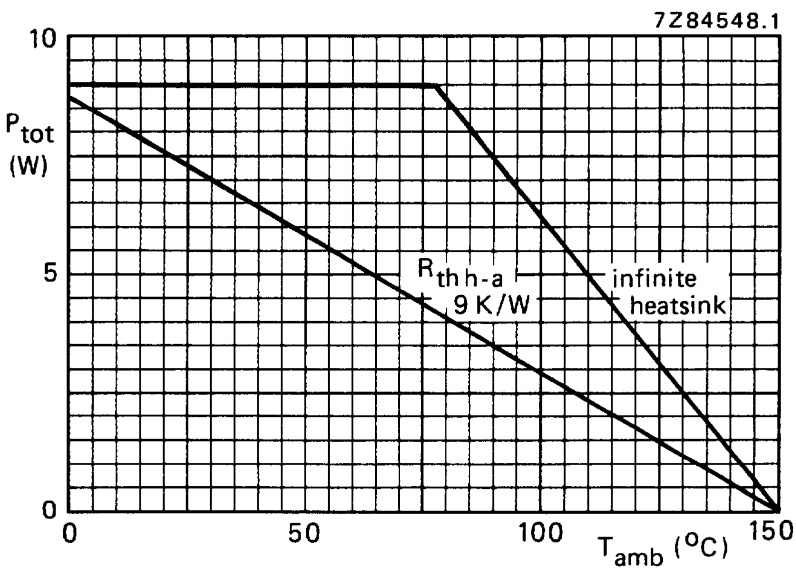



Fig.2 Power derating curves.

## HEATSINK DESIGN EXAMPLE

The derating of 8 K/W of the encapsulation requires the following external heatsink (for sine-wave drive):

10 W in 2 Ω at $V_P = 14{,}4$ V

maximum sine-wave dissipation: 5,2 W

$T_{amb} = 60$ °C maximum

$$R_{th\ j\text{-}a} = R_{th\ j\text{-}tab} + R_{th\ tab\text{-}h} + R_{th\ h\text{-}a} = \frac{150 - 60}{5,2} = 17{,}3\ \text{K/W}$$

Since $R_{th\ j\text{-}tab} + R_{th\ tab\text{-}h} = 8$ K/W, $R_{th\ h\text{-}a} = 17{,}3 - 8 \approx 9$ K/W.

## D.C. CHARACTERISTICS

| | | | |
|---|---|---|---|
| Supply voltage range (pin 3) | $V_P$ | | 6 to 18 V |
| Repetitive peak output current | $I_{ORM}$ | < | 4 A |
| Total quiescent current | | | |
| at $V_P$ = 14,4 V | $I_{tot}$ | typ. | 30 mA |
| at $V_P$ = 18 V | $I_{tot}$ | typ. | 40 mA |

## A.C. CHARACTERISTICS

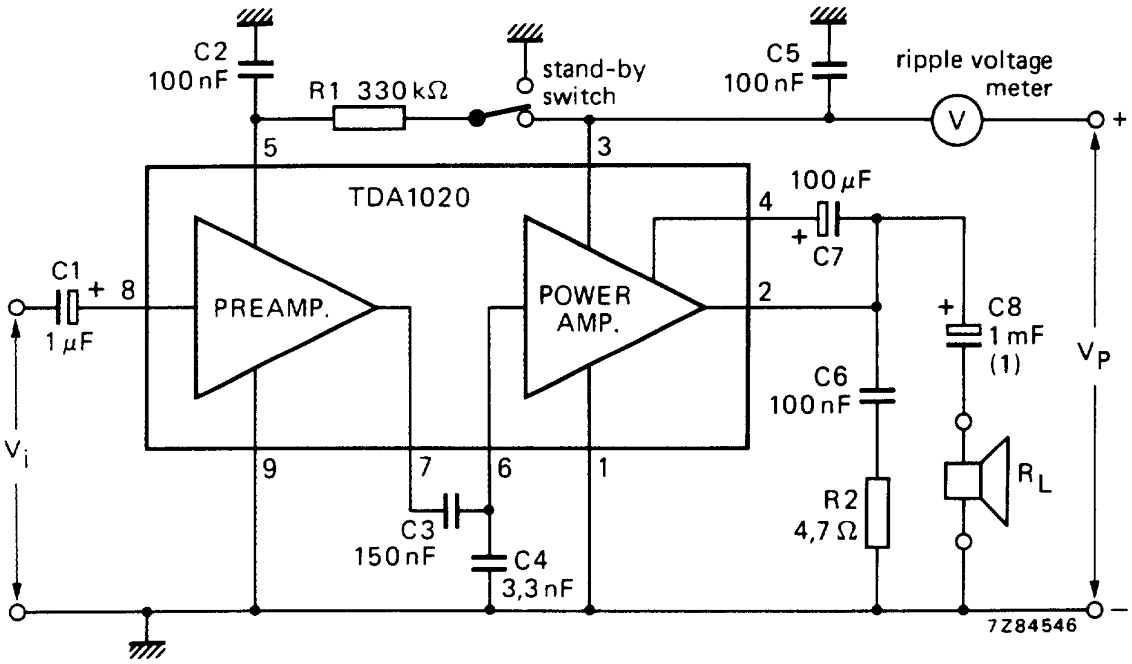
$T_{amb}$ = 25 °C; $V_P$ = 14,4 V; $R_L$ = 4 Ω; f = 1 kHz; unless otherwise specified; see also Fig.3

| | | | |
|---|---|---|---|
| Output power at $d_{tot}$ = 10%; with bootstrap (note 1) | | | |
| $V_P$ = 14,4 V; $R_L$ = 2 Ω | $P_o$ | > | 10 W |
| | | typ. | 12 W |
| $V_P$ = 14,4 V; $R_L$ = 4 Ω | $P_o$ | > | 6 W |
| | | typ. | 7 W |
| $V_P$ = 14,4 V; $R_L$ = 8 Ω | $P_o$ | typ. | 3,5 W |
| Output power at $d_{tot}$ = 1%; with bootstrap (note 1) | | | |
| $V_P$ = 14,4 V; $R_L$ = 2 Ω | $P_o$ | typ. | 9,5 W |
| $V_P$ = 14,4 V; $R_L$ = 4 Ω | $P_o$ | typ. | 6 W |
| $V_P$ = 14,4 V; $R_L$ = 8 Ω | $P_o$ | typ. | 3 W |
| Output voltage (r.m.s. value) | | | |
| $R_L$ = 1 kΩ; $d_{tot}$ = 0,5% | $V_{o(rms)}$ | typ. | 5 V |
| Output power at $d_{tot}$ = 10%; without bootstrap | $P_o$ | > | 4,5 W |
| Voltage gain | | | |
| preamplifier (note 2) | $G_{v1}$ | typ. | 17,7 dB |
| | | | 16,7 to 18,7 dB |
| power amplifier | $G_{v2}$ | typ. | 29,5 dB |
| | | | 28,5 to 30,5 dB |
| total amplifier | $G_{v\ tot}$ | typ. | 47 dB |
| | | | 46,2 to 48,2 dB |

| | | | |
|---|---|---|---|
| Input impedance | | | |
| preamplifier | $\|Z_i\|$ | typ. | 40 kΩ |
| | | | 28 to 52 kΩ |
| power amplifier | $\|Z_i\|$ | typ. | 40 kΩ |
| | | | 28 to 52 kΩ |
| Output impedance | | | |
| preamplifier | $\|Z_o\|$ | typ. | 2,0 kΩ |
| | | | 1,4 to 2,6 kΩ |
| power amplifier | $\|Z_o\|$ | typ. | 50 mΩ |
| Output voltage (r.m.s. value) at $d_{tot}$ = 1% | | | |
| preamplifier (note 2) | $V_{o(rms)}$ | > | 1 V |
| | | typ. | 1,5 V |
| Frequency response | B | | 50 Hz to 25 kHz |
| Noise output voltage (r.m.s. value; note 3) | | | |
| $R_S$ = 0 Ω | $V_{n(rms)}$ | typ. | 0,3 mV |
| | | < | 0,5 mV |
| $R_S$ = 8,2 kΩ | $V_{n(rms)}$ | typ. | 0,5 mV |
| | | < | 1,0 mV |
| Ripple rejection (note 4) | | | |
| at f = 100 Hz; C2 = 1 μF | RR | typ. | 44 dB |
| at f = 1 kHz to 10 kHz | RR | > | 48 dB |
| | | typ. | 54 dB |
| Bootstrap current at onset of clipping (pin 4) | | | |
| $R_L$ = 4 Ω and 2 Ω | $I_4$ | typ. | 40 mA |
| Stand-by current (note 5) | $I_{sb}$ | < | 1 mA |
| Crystal temperature for –3 dB gain | $T_c$ | > | 150 °C |

**Notes**

1. Measured with an ideal coupling capacitor to the speaker load.
2. Measured with a load resistor of 40 kΩ.
3. Measured according to IEC curve-A.
4. Maximum ripple amplitude is 2 V; input is short-circuited.
5. Total current when disconnecting pin 5 or short-circuited to ground (pin 9).
6. The tab must be electrically floating or connected to the substrate (pin 9).

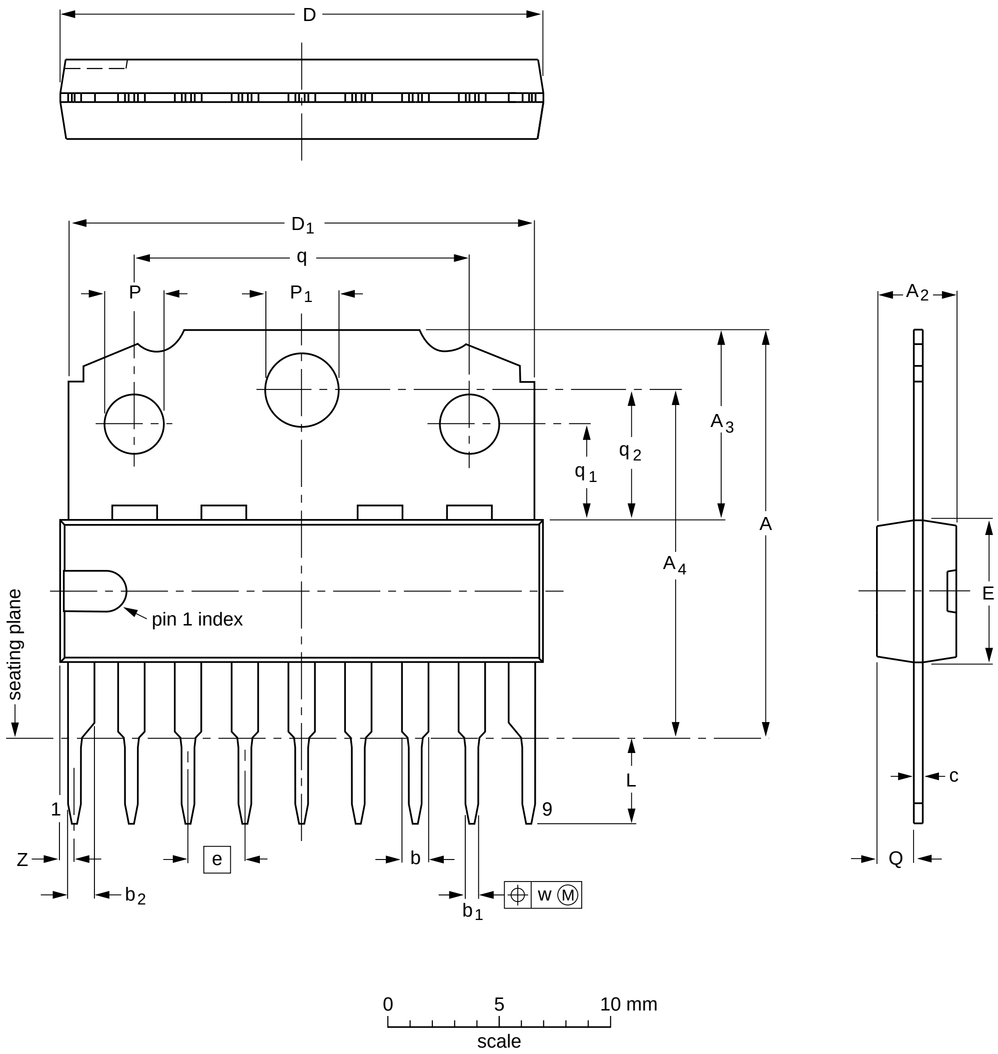



(1) With $R_L$ = 2 Ω, preferred value of C8 = 2200 µF.

Fig.3 Test circuit.

## PACKAGE OUTLINE

**SIL9MPF: plastic single in-line medium power package with fin; 9 leads** **SOT110-1**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | A | $A_2$ max. | $A_3$ | $A_4$ | b | $b_1$ | $b_2$ | c | D(1) | $D_1$ | E(1) | e | L | P | $P_1$ | Q | q | $q_1$ | $q_2$ | w | Z(1) max. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 18.5<br>17.8 | 3.7 | 8.7<br>8.0 | 15.8<br>15.4 | 1.40<br>1.14 | 0.67<br>0.50 | 1.40<br>1.14 | 0.48<br>0.38 | 21.8<br>21.4 | 21.4<br>20.7 | 6.48<br>6.20 | 2.54 | 3.9<br>3.4 | 2.75<br>2.50 | 3.4<br>3.2 | 1.75<br>1.55 | 15.1<br>14.9 | 4.4<br>4.2 | 5.9<br>5.7 | 0.25 | 1.0 |

**Note**

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | EIAJ | | | |
| SOT110-1 | | | | | | ~~92-11-17~~<br>95-02-25 |

## SOLDERING

### Introduction

There is no soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and surface mounted components are mixed on one printed-circuit board. However, wave soldering is not always suitable for surface mounted ICs, or for printed-circuits with high population densities. In these situations reflow soldering is often used.

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our *“IC Package Databook”* (order code 9398 652 90011).

### Soldering by dipping or by wave

The maximum permissible temperature of the solder is 260 °C; solder at this temperature must not be in contact with the joint for more than 5 seconds. The total contact time of successive solder waves must not exceed 5 seconds.

The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified maximum storage temperature ($T_{stg\ max}$). If the printed-circuit board has been pre-heated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

### Repairing soldered joints

Apply a low voltage soldering iron (less than 24 V) to the lead(s) of the package, below the seating plane or not more than 2 mm above it. If the temperature of the soldering iron bit is less than 300 °C it may remain in contact for up to 10 seconds. If the bit temperature is between 300 and 400 °C, contact may be up to 5 seconds.

## DEFINITIONS

| **Data sheet status** | |
|---|---|
| Objective specification | This data sheet contains target or goal specifications for product development. |
| Preliminary specification | This data sheet contains preliminary data; supplementary data may be published later. |
| Product specification | This data sheet contains final product specifications. |
| **Limiting values** | |
| Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability. | |
| **Application information** | |
| Where application information is given, it is advisory and does not form part of the specification. | |

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